PROCEEDINGS OF THE OIL REFINERY SYMPOSIUM

Held at Connecticut College, New London, Connecticut

November 16, 1974

Edited by

Mark J. McDonnell

Sponsored by

SURVIVAL, a student environmental group at Connecticut College

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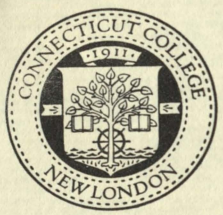

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INTRODUCTION

This report is a summary of the proceedings of an Oil Refinery Symposium held at Connecticut College on November 16, 1974 under the sponsorship of SURVIVAL (Connecticut College student environmental organization) and the Human Ecology Department. The purpose of the Symposium was to review the different aspects of locating an oil refinery in Southeastern Connecticut (Middlesex and New London Counties). Five speakers covered the following topics: economic effects, biological effects, legal aspects, the potential impacts of supertankers in Long Island Sound, and oil spills. A final manuscript was not received for Jeffrey Potter's * presentation on oil spills. However notes on his presentation have been added at the end. An introductory section by the editor has been included concerning additional information on the resources of the area that might be affected by a refinery, their value, and the anticipated nature of the refineries impact upon them has also been added.

In the past year or two, several proposals have been made for locating an oil refinery in New England. The energy crisis has been cited as a reason why such a facility is needed. To date, the states of Maine, New Hampshire, and Rhode Island have strongly opposed the building of an oil refinery on their shores. Within the last few months two companies, PEPCO International and In-O-Ven Corporation, have already proposed refineries for Connecticut, in the towns of Old Saybrook and Montville respectively. The questions may be raised: do the residents of the area want, or does the New England region need, a refinery? It is true the residents of New England use large quantities of petroleum products, particularly for transportation and home heating. It is also true that at present consumption rates the demand for petroleum products will be greater in the future. Yet, we must also realize that oil is a finite resource. Many predict that our present oil reserves will be greatly depleted in just fifty years. The question we must answer is do we want to jeopardize our environment now by continually increasing our demand for oil or do we want to keep our environment safe and develope alternate, more ecologically sound, sources of energy? There will definitely be some beneficial aspects in developing an oil refining facility in Connecticut, but we must be sure to weigh these against the possible detrimental affects. The following reports, should cast some light on many important aspects of locating an oil refining facility in Southeastern Connecticut.

* Jeffrey Potter is author of Disaster by Oil 1973 Macmillan Co.: New York, N.Y.

RESOURCES OF SOUTHEASTERN CONNECTICUT THAT COULD BE JEOPARDIZED BY THE DEVELOPMENT OF AN OIL REFINERY

Mark McDonnell
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Scenic, Cultural, and Historical Resources

Southeastern Connecticut is a unique area, combining readily accessable urban areas with a considerable amount of rural open space which supports an abundance of plant and animal life. The air and water are still relatively unpolluted. This area is endowed with a multitude of scenic, historical, and cultural sites. Examples in this area include the Connecticut river estuary, which now includes several wildlife refuges and a State Park, Essex Village, Chester-Hadlyme ferry, numerous historical homesteads, Watch Rock in Old Lyme, Rocky Neck and Harkness State Parks, Lantern Hill, Eugene O'Neil Theater, Yantic Leap in Norwich, Connecticut Arboretum, Stonington borough, Fort Griswold, Mystic Marine Aquarium, and Mystic Seaport just to name a few. Except for a few densely populated areas most buildings and industrial structures are relatively low in height, minimizing the presence of discordant features in the landscape. This noticeably improves the scenic quality of Southeastern Connecticut.

Any proposal for an oil refinery in the Southeastern Connecticut region should take into consideration the effects it would have on the scenic, cultural, and historical sites in the region. Oil refineries are not isolated entities which only effect the immediate area in which they are located. An oil refinery and its supporting facilities would have a substantial impact on the air, land, and water quality of the entire region (10). The Governor's fact finding task force on refineries states," In terms of the total annual tonnage emitted of three major pollutants (hydrocarbons, sulfur oxides, and particulates), an oil refinery would be the largest single air pollution source in the State, whether it is a 100,000 or a 400,000 barrels per day (bpd) facility."(12) An oil refinery is no obscure facility. One proposal by the In-O-Ven Corporation for a refining plant in Montville would include 500 acres of huge oil storage tanks, possibly three stacks 300 feet tall and 250 acres of fractioning towers, piping and other refinery equipment (3). This does not include the docking facilities for large supertankers needed to supply the plant or the necessary pipelines needed to carry the oil into and out of the refining facility. It appears obvious that such a complex would most definitely have some effect on the scenic quality of a sizable area. It has also been intimated that the presence of a refinery would attract other industries ie. rubber, plastics, and other petrochemicals to the area. These would certainly have an effect on the scenic quality of the entire area. What we must keep in mind is that these scenic, cultural, and historical sites are not single entities. Their appreciation and value is very much influenced by the quality of life around them. We must question any development that could possibly have a detrimental effect on the quality of these resources.

RECREATIONAL RESOURCES

Southeastern Connecticut provides a variety of recreational opportunities. Of most importance is the fact that the area borders on Long Island Sound, a large semi-enclosed body of water covering 1300 sq. miles of surface water and approximately one thousand miles of coast line (5). The state of Connecticut only has 253 miles of coast line of which a third is found in Southeastern Connecticut. Recreational activities in the coastal zone area include camping, picnicing, boating, fishing, and use of the beaches.

Of the total miles of guarded swimming beaches along the coast of Connecticut, approximately 14% of them are found in Southeastern Connecticut. The pressure on these swimming facilities is generated by 760,000 people in 1970 or approximately 25% of the state population (4).

Of the total number of acres of picnic areas located in Connecticuts' coastal zone approximately 8% is found in Southeastern Connecticut. The demand on this area is generated by 200,000 people or approximately 6.8% of the state population (4).

Of the total number of boat ramp lanes on the Connecticut coast 36% are found in Southeastern Connecticut. The demand on these ramp lanes is generated by a population of about 540,000 or approximately 18% of the state population in 1970 (4).

Of the total number of boat slips and moorings in Connecticuts' coastal zone approximately 24% are located in Southeastern Connecticut. Of the total number of crafts berthed in Connecticuts' coastal zone approximately 46% are located in this region. The total number of boats which use the sound has been estimated at around 80,000. The demand on the slips and moorings in the Sotheastern Connecticut region is generated by a population which in 1970 totals a little over a million people or about 43% of the state population (4).

Of the total number of acres of camp grounds in Connecticuts' coastal zone over 21% are found in Southeastern Connecticut. The demand on these camping areas is generated again by a little over a million people.

Recreational sports fishing on Long Island Sound has become an increasingly popular sport. It has been estimated that there were some 49,000 salt water anglers in Southeastern Connecticut alone in 1970 with an expected 85,000 in the year 1990 (6). The total number of salt water anglers in Connecticut during 1970 has been estimated at 340,000 (6). With the addition of 475,000 anglers from the New York area the total number of anglers using Long Island Sound during 1970 comes to around 850,000 (6). The recreational value of sports fishing in Long Island Sound has been estimated to be around $13 million (6).

It is obvious that a considerably large portion of Connecticuts' population, as well as a good number of out-of-state residents, use Southeastern Connecticut's recreational facilities.

The economic benefits derived from these facilities are highly significant. Any proposal of an oil refining facility in this area should seriously consider the possible detrimental effects that could jeopardize the value of these recreational facilities. Adequate recreational facilities are important to our standard of living.

Long Island Sound

Of all the resources of Southeastern Connecticut none are probably as valuable as Long Island Sound. The Long Island Sound Study Report (5) states, " Long Island Sound is one of the nation's unique and irreplaceable natural resources." The Sound serves Southeastern Connecticut in a multitude of ways,from affecting the weather to providing a vast array of recreational opportunities as previously mentioned. The sound is made up of many different habitats including coastal marsh[1], benthic[2] and epibenthic[3] communities, all of which support unique plant and animal populations.

Of the total number of tidal wetlands present in Connecticut in 1914 over half have since been destroyed. Vast acres have been filled, built on, and even used as garbage dumps, with little or no consideration by towns or municipalities as to their ecological significance. Since the initiation of Public Act 132, The Tidal Wetlands Act of 1970 (11), the damage to tidal marshes in Connecticut has been greatly reduced. In the words of the act," It is declared to be the public policy of this state to preserve the wetlands and to prevent the despoliation and destruction thereof." To date Connecticut has 15,500 acres of tidal marshes of which over 3,000 acres are found in Southeastern Connecticut. (7). These tidal marshes play an important ecological role in the function and maintance of our total ecosystem. Tidal marshes function as pollution filters, nutrient sinks, and sediment traps as well as serving as important agents in the reclamation, stabilization, and protection of our coastal lands. Tidal marshes serve as natural barriers against the pounding force of waves and as cushioning agents against the detrimental effects of hurricanes. Tidal marshes are covered by a mosaic of unique salt tolerant plants. These marshes provide a habitat for over 200 life forms including 60 species of birds, 20 species of mammals, 15 species of reptiles, and a multitude of other species of fish, mollusks, and insects.(14,

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1 Wetlands refer to those coastal lands which are slightly submerged or at least inundated with water once a year. These areas commonly support a unique plant and animal community.

2 Benthic refers to the communities of plants and animals which exist on the sea floor.

3 Epibenthic refers to the other communities in the sound except those which live in the benthic zone.

Probably the most important role of the salt marshes is the significant amount of nutrient input it provides to the Sound. This input enables the Sound to support a large and diverse population of marine and bird populations. Steever (16) reports the productivity of a 30 acre salt marsh in Southeastern Connecticut to be as high as 93 tons a year (8,058,600 kg/yr.) It has been stated that Long Island Sound receives a substantial annual input of over 100,000 tons of plant material from these marshes in the form of detritus. (7). Tidal marshes are truely important to the Sound's ecosystem.

The benthic and epibentic communities of the sound are not quite as well known by many due to the fact they are under water. The benthic community is made up of a large variety of plants and animals which live on the sea floor. Many species of algae can be found there as well as such marine organisms as clams, oysters, snails, crabs, lobsters, flatfish, sponges, worms, starfish, and sea cucumbers just to name a few (13). To illustrate the abundance of individual species found in these communities in the sound, a study off the town of Waterford (9) revealed the following number of organisms per .36 square meters which is about 2 feet by 2 feet- 1914 Crustacea representing 5 species, 342 Mollusca also representing 5 species, and 200 Polycaeta also representing 5 species. These samples are, of course, variable depending upon location and time of year, but these numbers at least give us some insight as to the large number of these organisms that live on the floor of the Sound.

The epibenthic communities are dominated by finfish but also include a number of other life forms. The study previously mentioned revealed 7217 Mollusks, Polycaetes, and Crustaceans in an area of 12 square meters which is about 108 square feet. Again these numbers are variable and only cover a small sample area of the Sound they at least give us some insight as to the phenomenal number of these organisms which live in the epibentic zone. Long Island Sound supports an abundant and diverse population of finfish, although their numbers have been declining in the past decade (15). Those of particular importance to the area include American shad, memhaden, striped bass, blue fish, winter and summer flounder, Atlantic mackeral and taugoa just to name a few. (15). Many of the fish using the Sound are migratory. The main entrance into the Sound is via the Race at the eastern end. The Long Island Sound Study (6) states,"certainly the eastern end of the Sound is of primary importance as a migratory entrance, and enviromental modifications in this area could significantly alter migration conditions."

Long Island Sound also supports a large and diverse bird population. The total number fluctuates from season to season, but is greatest during the spring and fall migration (2). Some of the more common birds present include: herring gulls, ducks, terns, sandpipers and sparrows. Those not so common birds present include: green heron, common and snowy egret, yellow crowned night heron, osprey, and the great blue heron. The 1971 Christmas bird census revealed a total of 43055 birds, representing over a hundred species, in New London and Middlesex Counties alone (2). This has been called a conservative estimate and is only an indication as to the total number of birds present.

The total population of waterfowl, which includes 15 species of birds, on Long Island Sound in 1970 is estimated at 150,000 birds (6). Long Island Sound is truely a rich area for bird life. We should not underestimate the importance of the Sound's habitats to the survival of these birds. The importance of the Sound's habitats is stated by the Long Island Sound Study Report (6)- "The wetlands serve as a major wintering terminus for migratory birds from the Labrador-Quebec-Newfoundland region and, as such, they provide habitat for the migratory populations of the Atlantic Flyway. The fact that these populations can fluctuate unevenly over a period of years suggests that they are highly susceptible to environmental changes. Further loss of wetland habitat in significant proportions could lead to drastic reductions in the waterfowl populations of the Sound, as well as those of the Atlantic Flyway."

This is just been a glimpse of the many different types of organisms present in the many different communities in and around the Sound as well as some indication as to the magnitude of their numbers. One must keep in mind the importance of the Sound's habitats in supporting these organisms when we discuss the possibility of an oil refinery in the area. The Govenor's task force (12) states " The use of supertankers on Long Island Sound will, over a period of time, result in the spillage of considerable quantities of oil. " Oil is really never eliminated it is just dispersed which leads to considerable buildup of oil concentrations in certain areas. (1). Oil has been found to adversly affect habitats like those found in Long Island Sound (1). The question is does one want to jeopardize these habitats along with the plants and animals which populate them by building an oil refining facility close to the Sound? It appears to the author that these habitats are far to ecologically important to the function of our biosphere to gamble with.

Industrial and Economic Resources

An oil refining complex in greater Southeastern Connecticut to many people means moretary gains in the form of increased taxes, greater utilization of local products, and a new demand on the local work force. This particular subject will be delt with in more detail in the article concerning economic effects. The point being made here is we must weigh the beneficial economic effects of a refinery in this area against the possible detrimental effects it could have on our present economic resources.

The New London Chamber of Commerce reports (8) that during the summer months July through August the population of Southeastern Connecticut increases by 40,000 people. In addition to this, another 2 million people visit the area during this time. This increase in population provides substantial economic benefits to the area. The question is will an oil refinery complex in the region jeopardize these present economic benefits by lowering environmental quality in the area, thus discouraging summer visitors. The question can not be readily answered but the possibility certainly does exist.

Already previously mentioned is the phenomenal amount of money involved in the sports fishing industry on Long Island Sound, approximately $13 million. In addition to this is the value of the commercial fishing industry in Connecticut. In 1968 4,054,000 pounds of commercial finfish were caught worth $310,000 and 5,469,000 pounds of shellfish, crabs and lobsters worth $1,220,000 (15). The grand total of economic worth of finfish and shellfish from the Sound is probably in the neighborhood of 15 million dollars. Any possible economic benefit produced by an oil refinery in the area must be weighed against the possible detrimental effects such a facility would have on the shellfish and finfish of the sound.

The building of a refining facility in Southeastern Connecticut, or New England, for that matter would depend on whether or not a deep water port could be built. The reason for this is the only economically feasible way of suppling the refiner with oil would be by super tankers or very large crude carriers (VLCC's). The fact is no such port exists on the east coast. The first area to establish such a port will undoubtably become a major terminal, serving the whole of New England. Is any portion of Southeastern Connecticut suitable for such a facility? The author feels that all potential aspects of building an oil refinery complex should be closely scrutinized in order to avoid unwanted stress and damage to the area.

Long Island Sound provides cooling water for a number of industries as well as one nuclear power plant at the moment and others in the near future. This leads one to ask the question: are we putting our future electrical power generation in jeopardy? It would seem inevitable that in the event of an oil spill close to the Millstone Nuclear power plant's water inlets that the plant would have to close down or risk fouling their cooling systems. The In-O-Ven proposal has stated their plans call for a deep water port some 3 miles from Millstone Point, the site of one nuclear power plant with two more being built presently.

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Master's Thesis. Connecticut College.

ECONOMIC CONSIDERATIONS CONCERNED WITH LOCATING AN OIL REFINERY IN SOUTHEASTERN CONNECTICUT

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Recently, selected New England areas have been the subject of heated debates and intensive investigations regarding the construction and development of oil refinery facilities. To some degree this interest has been precipitated by changes in economic conditions. Specifically, "changes in crude sources, ship sizes, and tariff regulations" have been cited as significant factors which permit and encourage the location of refineries in the vicinity of New England petroleum marketplace.[1]

Oil refineries, similar to the development of any major industrial complex, will exert significant economic impacts on a specific geographic location. The magnitude of these potential economic effects will be influenced by: the capacity, complexity, and location of the refinery facility; the effectiveness of local, state, and federal regulations;[2] and the size of certain economic factors (for example, the unemployment rate and employment multiplier). Proper economic evaluation of any resultant impacts requires an unbiased assessment of potential benefits and costs.

In any benefit-cost analysis, it is important to recognize that benefits and costs accrue to individuals, groups, and economic sectors in varying amounts. For an oil refinery, the major participants would include:

(1) the developing corporation;
(2) the community (town or city) in which the refinery will be located;
(3) the surrounding region and state;
(4) the consumers, taxpayers, and business in the community and surrounding region.

In addition to the identification of the relevant groups and sectors, it is also important to realize that economic effects may be primary or secondary in nature. Although all economic consequences are important, the main focus of this paper is directed toward primary benefits and costs. However, in selected discussions reference will be made to important induced and indirect economic impacts. A list of important categories in which economic effects are likely to occur would include:

(1) employment;
(2) taxes;
(3) supply and price;
(4) environmental consequences;
(5) alternative plans of action.

Since the discussion with respect to the above categories is non-site specific, only a general outline of major economic considerations pertinent to the development of onshore refineries is presented. Specifically, the important conclusions of selected economic studies relating to the feasibility of developing an oil refinery in New England are advanced. (See reference list)

EMPLOYMENT

Employment benefits generated by oil refinery developments are in terms of direct, indirect, and induced employment opportunities. To provide some idea of this labor demand, estimates of primary and secondary labor requirements, which are presented in selected oil refinery studies, will be discussed. Although refinery developments stimulate the demand for labor, the extent to which the increased demand represents an economic benefit must be assessed in terms of some economic criteria. Specifically, potential employment benefits will be evaluated in terms of the size of the geographic area under consideration, the skills of the available labor force in the given area, and the employment status of a potential labor supply.

Direct Employment

Direct employment attributable to an oil refinery development involves the steady-state and the construction labor forces. The size of each component of this direct labor requirement depends on the capacity and/or the complexity of the refining facility. Estimates for 250,000 B/D refinery reveal that the steady-state labor force may range between 200 and 500 employees. Where, "simple" refineries producing primarily residual fuel oil and naptha employ about 200, the "complex" refineries producing gasoline and lighter distillates employ about 500 people.[3]

A breakdown of a potential steady-state workforce for a 250,00 B/D refinery is illustrated in Table I. The total refinery labor requirement is for 500 employees. With an average employee income of $10 thousand per year, the average annual wage bill for this refinery is $5 million. Since the steady-state labor force is a function of refinery capacity and complexity, it is difficult, if not impossible, to accurately estimate direct labor requirements for other refining facilities.[4]

TABLE I

ESTIMATED STEADY-STATE LABOR FACTORS FOR

A 250,000 B/D REFINERY

	Estimated Employment	Estimated 1972 Average Yearly Salary/Wage Level
Total Employment	500	$ 10,000
Administrative	50	13,800
Operative and Maintenance	400	10,600
Other (Lab, Safety, etc.)	50	10,000

Reported in: The Impacts of an Oil Refinery Located in Southeastern New Hampshire: A Preliminary Study, the University of New Hampshire, 1974

The estimated number of construction laborers for this 250,000 B/D refinery is presented in Table II. For the three year construction time

period, an average of 2,2000 construction workers would be required with a corresponding average annual payroll of $28.5 million. However, because of the existence of economies of scale in construction, it is not appropriate to use a simple proportionality factor to adjust construction labor requirements relative to changes in refinery size.[5]

Indirect and Induced Employment

As previously indicated, employment benefits may also be indirect and induced. Indirect employment opportunities occur as the result of the demand for refinery inputs, while induced employment effects are generated by increases in consumer income and spending which stimulates business activity in less related sectors of a local, regional, or state economy. However, for any geographic location the number of indirect and induced job opportunities depends on the area's employment multiplier. From the 500 steady-state refinery employees, the Arthur D. Little study projects an additional 1500 job opportunities with an estimated annual income of $11.5 million.[6]

In addition, potential downstream industrial development is often advanced as a major source of employment. While oil refineries " ...are capital intensive facilities with relatively few employees, related petro-chemical industrial development is ... the (potential) source of large numbers of new jobs." [7] Although accurate estimates of downstream industrial development are unavailable, the ALD study estimated that refinery capacity would have to exceed 650,000 B/D before any substantial petrochemical development would occur. [8]

TABLE II

ESTIMATED CONSTRUCTION LABOR FACTORS FOR

A 250,000 B/D REFINERY

	Estimated Labor Force	Estimated 1972 Average Yearly Salary/Wage Level
Total Construction Employment	2,200	$ 13,000
Construction Management	200	16,000
Skilled	1,400	14,000
Semi-skilled	400	10,000
Unskilled	200	8,500

Reported in: Perspective on Oil Refineries and Offshore Unloading Facilities: Proceedings. The Fourth New England Coastal Zone Management Conference, April 1974.

Economic Criteria

In assessing the merits of oil refinery development, the number of job opportunities for local, regional, and state residents is frequently regarded to be of paramount importance.

Although many factors may influence the potential employment of these residents, the size of the geographic area under consideration and the skills of the available labor supply appear to be important considerations influenc ing the magnitude of employment benefits.

A review of estimated refinery employment opportunities lends support to the importance of the above labor considerations. The ALD Massport study estimates that 90 per cent of the steady-state refinery labor force will be Massachusetts residents;[9] while a University of Rhode Island study reveals that only 33 percent of a refinery staff will reside in a smaller geographic area, i.e., the town of Tiverton, R.I.[10] The ALD study also shows that in excess of 70 per cent of the onshore construction labor force and the refinery operating and maintenance employees will come from Massachusetts; while top eschelon managerial positions and the offshore construction work-force (i.e., the more complex and skilled jobs) will require nearly 100 per cent labor relocation to this state.[12] In addition, all of the reviewed studies concluded that the general complexity of oil refinery jobs precludes significant employment opportunities for most of the unemployed in a given geographic area. It should be noted, however, that estimates of potential job opportunities are frequently based on specific assumptions regarding the length of the training period and/or the granting of a preferential employment status to residents of a given area. Thus, estimated employment opportunities for local, regional, and state residents may be adversely affected by a contraction of the training period and/or the existence of obstacles to preferential hiring (e.g., labor union requirements).

Monetary evaluation of potential employment benefits should take into consideration the current employment status of the resource. Since oil refineries afford little employment opportunities for a large portion of an area's unemployed, the dollar value of these benefits should be adjusted to reflect any loss of employment due to refinery development. Thus, it is inappropriate to measure an area's aggregate employment benefit in terms of the total wage bill resultant from refinery development. Correct monetary measurement of labor benefits should equal the total wage bill from development minus the area's loss in wages resulting from job transfers.

TAXES

An expectation generally held with regard to tax relief in communities which are considering the development of an oil refinery facility in their locale is that the new industry will result in a reduction of the tax rate. There are, however, relevant factors to keep in mind when evaluating possible tax benefits. First, the inevitable "tax-exemptions" which are allotted to industries should be considered; second, the propen-
impact of lower tax rates on community development and expansion; and fourth, the possible affect of an increased tax base on state aid to the community.

In consideration of tax exemptions, it should be noted that portions of a refinery's asset value frequently are not taxed as real property. Generally, a refinery's manufacturing and processing equipment are exempt from property taxes. Thus, a refinery's contribution to increased community tax revenue (although it may be substantial) is reduced by these exemptions.

In areas where refineries do contribute significally to local tax revenue, the implication that a reduction in the tax rate will occur is subject to debate. Local governments may choose to spend additional revenues on general public services and/or services for the refinery. The University of Rhode Island study concluded that " ... town governments, like most governments, seem to regard increasing revenue as a basis for increasing expenditures, rather than as a basis for reducing tax rates." [12] However, it should be noted that expanded services by the local government may comply with the desires of a substantial portion of the community's residents. With respect to increased local government expenditures, important considerations should include: How the community infrastructure is changed, and what proportion of an increase in public services is for the sole benefit of the refinery.

Should local government officials choose tax relief, the reduction in the tax rate may attract new housing and other types of development to the community. As a result, pressure for increases in the tax rates may ensue. Assuming no refinery expansion and no other types of major local development, the University of New Hampshire refinery study provides estimates of the time period required for tax rates to return to their pre-refinery development level. For a town population of 500 the estimate benefit period of a lower tax rate extended from 35 to 50 years, while for a larger town with a population of 25,000 the estimated period diminishes to 10 years. [13]

Consideration should also be given to the impact of an increased tax bases on state aid. One possible consequence of increasing the tax base in the town of Tiverton, R.I. was a reduction in state aid for education. For example, an increase in the town's tax base of $50 million may entail a reduction in construction aid of nearly $40 thousand per year (based on a school building program of $6.5 million) over the next 20 years, and a decline in state support for shcool operating expenses of approximately $53 thousand. [14]

PRICE AND SUPPLY

In recent years, New Englanders have become very concerned with the price and supply of petroleum products. The relevant issues regarding price and supply appear to be: (1) a possible reduction in the price of petroleum products as the result of local refinery development, and (2) the provision of a supply cushion to protect the area against possible supply disruptions.

With respect to the first issue, it is unrealistic to assume that the development of a single oil refinery in a given New England area will significantly lower price.

Due to the absence of rivalry, an individual oil refinery should be inclined to sell at the going price in the New England petroleum market-place. However, if several oil refineries were to be developed by both major and independent oil companies, then the possibility of rivalry and lower petroleum prices is likely.

In terms of maintaining supply, oil refineries provide temporary cushions against possible dislocations. Historically, the United States has "... maintained only a 15-20 day product supply in storage in market areas without refineries, ... (while) refineries ... normally operate with an average of 45-60 days of combined supply of crude oil and products on hand." [15] Given this data, it is clear that the development of oil refineries in the New England area would provide a temporary supply cushion. However, one must question whether refinery development is the most expedient means to augment storage capacity in New England. When confronted with a serious crisis, " ... federal allocation regulations (are likely) to be in effect, as in the recent embargo, and reduce any local advantage over other parts of the country." [16]

ENVIRONMENTAL CONSEQUENCES

When evaluating the benefits and costs of an oil refinery development, consideration must be given to possible environmental consequences. Although technological advances have occurred which enable refineries to cope with certain types of air and water pollution, the environmental issue is far from resolved. At the Fourth New England Coastal Zone Management Conference, it was noted that " ... new refineries could not meet the (EPA's) guidelines for ambient hydrocarbon (HC) levels ... (and that) important effects such as noise, odor, and illumination are not fully controlled by EPA standards. " [17]

Although it is generally recognized that environmental degradation may impose significant economic costs on a given area (community, region, or state), the exact measurement of these costs often pose difficulties for economists. Some environmental consequences are quantifiable in dollar terms. For example, a community's added costs for pollution abatement and environmental monitoring may be determined from actual dollar expentitures, while losses to commercial fishing may be estimated from declines in revenue. Other environmental impacts are extremely difficult if not impossible to monetize. This category of adverse environmental effects may include declines in sport fishing activities, noise and odor pollution, and the destruction of a scenic amenity. Although some environmentally imposed costs are not easily quantifiable in dollars, all environmental effects must be included in an evaluation of the net benefits of an oil refinery development.

ALTERNATIVE PLANS

Any evaluation of net benefits attributable to a particular project should include an economic analysis of alternative development plans.

For example, consideration should be given to alternative land uses at the refinery site, and foregone industrial development (housing, research and development, recreation, and insurance)[18] in the vicinity of an oil refinery. Thus, the magnitude of foregone incomes and tax revenues as a result of refinery development should be estimated.

FOOTNOTES

1. Richard Williams, "Social Considerations," in Perspective on Oil Refineries and Offshore Unloading Facilities: Proceedings, The Fourth New England Coastal Zone Management Conference, Durham, N.H., April 1974, p. 61.

2. Ibid., p. 61.

3. Ibid., p. 63

4. The Impacts of an Oil Refinery Located in Southeastern New Hampshire: A Preliminary Study (The University of New Hampshire, Durham, NH, 1974), Chapter IV, p. 6.

5. Ibid., Chapter IV, p. 4.

6. Williams, "Social Considerations," p. 63.

7. Ibid., p. 66.

8. The Impacts of an Oil Refinery Located in Southeastern New Hampshire, Chapter IV, p. 15.

9. A Preliminary Economic Study of Alternative Methods of Supplying Petroleum Products to Eastern Massachusetts, Arthur D. Little, Inc., 1973.

10. Paul Mlotok, A Study of the Economic Implications of the Refinery Proposed for Tiverton, RI, (University of Rhode Island, Kingston, RI, Occasional Paper 70-345, December 1974), p. 17.

11. A Preliminary Economic Study of Alternative Methods of Supplying Petroleum Products to Eastern Massachusetts.

12. Mltok, A Study of the Economic Implications of the Refinery Proposed for Tiverton, RI, p. 12.

13. The Impacts of an Oil Refinery Located in Southeastern New Hampshire, Chapter V, p. 10.

14. Mlotok, A Study of the Economic Implications of the Refinery Proposed for Tiverton, RI, p. 11.

15. Williams, "Social Considerations," p. 68

16. Ibid., p. 69.

17. Ibid., p. 70.

18. The Impacts of an Oil Refinery Located in Southeastern New Hampshire, Chapter IV, p. 20.

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ENVIRONMENTAL IMPACTS OF AN OIL REFINERY IN SOUTHEASTERN CONNECTICUT

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In evaluating the potential ecological impact of an oil refinery in southeastern Connecticut, one must consider the present impacts upon the affected sites and the increased environmental assaults that will result from its construction and operation. Therefore, the site selected in the town of Montville, including the surrounding airshed and watershed, and Long Island Sound, where the import and export of the raw and processed petroleum products will occur, must be considered in any analysis.

PROPOSED DEVELOPMENT SITE

The proposed 1,000 acre site lies in the Hunts Brook watershed (between Old Colchester Road and Fire Street) where three fly ash sites now totalling some 244,000 cu. yards of ash (produced by Northeast Utilities, Montville Plant, deposited by N.B. King during the 1960's) are contributing to the contamination of the watershed. A recent study financed by Northeast Utilities indicated that $400,000 will be required to rehabilitate the watershed. Certain wetlands have been destroyed by the fly ash deposits; others are being adversely affected or are serving as pollution filters preventing more serious downstream pollution. What will be the fate of these fly ash deposits in reference to watershed rehabilitation if a refinery is located on the site? Will the watershed be rehhabilitated or will its contribution to provide a future water supply be destroyed forever? In terms of long range land use planning this watershed may be more valuable in serving the region as a future water supply. A refinery requiring 250 acres for refinery machinery and 500 acres for storage may well negate this possibility.

The Airshed-- The air quality of southeastern Connecticut is generally superior to areas westward along the Sound. However, at times polluted air from the greater metropolitan region to the west sweeps across southeast Connecticut. Studies of Bormann and Likens (1974) also suggest that acid rains are common in New England. Sulphur dioxide and nitrogen oxides in the atmosphere combine with the rain to form acidic rains as low as pH 3.0-4.0. The effects of such rains in the lakes of Sweden have already resulted in fish kills. The long range effects on aquatic organisms and the potential for increased leaching of soil nutrients from the soil are of major concern to ecologists. The Cherry Point, Washington refinery, one-fourth the size of the one proposed, produces over 30 tons of sulphur dioxide per day with the best technology currently available (Phillips 1974). Therefore, one can anticipate 120 tons of SO_2 per day emitted into the airshed of southeastern Connecticut. At times auto emissions and existing industry of the region bring our air pollution levels above permissible standards. According to the Connecticut Department of Environmental Protection, the proposed refinery (400,000 barrels per day) would emit about 100 tons of pollutants daily. There is little question that the acidity of the rainfall will increase in

this region, possibly to the deleterious levels reported in Europe. There are preliminary indications that the productivity of our New England forests is already being reduced by the current levels of the acid rains. It is ironic that the newest technology involving the removal of particulate matter is actually intensifying the problem rather than solving it. Previously the particulate material tended to absorb the sulphurous compounds and ameliorate their effect in the atmosphere. Acid rains pose a new and potentially serious environmental problem with subtle yet wide spread effects.

Solid and Liquid Wastes-- It is estimated that 40,000 tons of solid waste may be produced annually from the proposed refinery. Are disposal sites available for such quantities of material, some of which are potential pollutants? Extracts from water polluted with oil refinery effluent have been found to cause cancer in mice (Hueper & Ruchhoft 1954) thus the potential of cancer-producing substances entering the watershed is possible, as well as carcinogenic hydrocarbons entering the aquatic environment through oil spills.

LONG ISLAND SOUND

Long Island Sound is already heavily impacted by man as documented by the Long Island Sound Regional Study (1974). Some 32 power generating plants are using and warming the water. This along with other industrial use will increase 50% by 1990. In 1968 there were 20 active commercial ports with 68% of the tonnage petroleum products. Over 63,000 power boats use the Sound. Even the potential deleterious impact of motorized craft has not been fully evaluated. It is estimated that 10-33% of the fuel of motor boats is discharged into cooling water exhaust steam. Certain of these hydrocarbons are carcinogenic. Salt water fishermen number some 200,000 with the boating-fishing resource totalling a $1.5 billion resource. Only half the tidal marshes remain in Connecticut and the marine fisheries of Long Island Sound have suffered a $500 million loss over the last 50 years due to changing water quality (Alexander & Hollman 1974). The Thames River which will be used to export the refined fuel is still polluted and therefore certain recreational uses are restricted. The Submarine Base is a major user of the Thames channel. From a national defense viewpoint will heavy oil tanker traffic and nuclear submarines result in a desirable pattern of useage of the Thames River and Long Island Sound?

In this context can we afford further environmental impacts that will tend to counteract remedial measures to upgrade the quality of the Sound? What potential additional problems might one anticipate with a refinery? Since a large portion of the refined crude would be exported, the potential for oil spills, based on the number of transfers, will be increased rather than decreased. With this as a reality, it is relevant to briefly analyze the effects of oil on marine organisms in the open estuarine waters and on the contiguous tidal wetlands. Since crude and refined fuel oil differ in their biological effects each will be briefly considered.

Effects of Crude Oil-- At the Milford Harbor (Conn.) spill, heavy crude (Bunker no. 6) tended to smother intertidal organisms (The Research Corp. of New England 1973). Many organisms were tainted. However, bivalves such as mussels tended to survive fairly well by closing their shells. In contrast, the marsh vegetation was killed above ground, but later resurged if the oil had not penetrated the marsh substrate. In controlled experiments marine snails showed mortalities after being subjected to crude oil for six hours (Crapp 1971).

In Maine, seaweeds may absorb the oil and then break off to float and contaminate other areas. It has also been shown that the rockweed Fucus will continue to leak oil back into the environment (Welsh 1972).

Effects of Refined Petroleum Products--It has also been documented that no. 2 fuel oil is much more toxic than no. 6 or the crudes. Total mortality of a mud flat community occured within five days in the West Falmouth (Mass.) spill (Sanders et al. 1972) and no reproduction was evident until the following year. In the Bartlett Reef spill on the Niantic Bay area intertidal kill was restricted to discrete areas of heavy contamination (U.S. Environmental Protection Agency 1974). Immediate mortality of mussels,bivalves, sea stars and sea urchins can occur with some repopulation occurring, but certain groups such as mussels and echinoderms still were reduced after seven years (Nelson-Smith 1968).

Accumulation of oil in the marsh sediment is a further problem providing a source of continuing contamination to the invertebrate population. Although biological degradation occurs, it is often slow with certain of the more toxic aromatics persisting.

The tidal marsh may be adversely affected not only by crude but also by no. 2 fuel oil. At West Falmouth, Burns & Teal (1971) reported total mortality of flora and fauna in the immediate vicinity of the spill. A year later salt meadow cordgrass (Spartina patens) was still dead. Where cordgrass died, the annual glasswort (Salicornia sp.) dominated. Both the seaweeds and grasses hold the oil and later it may be released into the detrital food chain. The ribbed mussel (Modiolus demissus) accumulated significant amounts of the hydrocarbons. Contamination of the sediments extended to a depth of 58 cm where it persisted up to two years with little degradation.

At Falmouth, no. 2 oil resulted in total loss of benthic bivalves and amphipods (especially sensitive and important in the marine food chain) and partial loss of polychaetes. Oysters and scallops took up the oil, but biodegradation retained in the lipids and aductor muscle which is marketed in the scallop. After a year hydrocarbon levels were still high, especially the more toxic aromatics. In fact, the pollutant spread to uncontaminated shellfish (Blumer et al. 1970).

CARCINOGENIC EFFECTS OF OIL

There is a growing concern that chronic diseases of man, especially cancer and neurological disorders, may be largely related to environmental

pollutants. According to some authorities 80-90% of the cancers are caused directly by agents of the environment (Butler et al. 1974). Although there is a dearth of direct evidence that oil pollution can result in cancerous growth, extracts from water polluted with oil refinery effluent, as previously mentioned, have been found to cause skin cancer in mice (Hueper & Ruchhoft 1954). A comparison of bryozoan colonies from areas with oil pollution and non-polluted waters showed abnormal growths in oil polluted water (Powell et al. 1970). Uncontrolled growth was also induced experimentally by placing bryozoans in oil-contaminated waters. It should be noted that petrochemicals are among the most potent carcinogens known. The polycyclic aromatic hydrocarbon--3,4, benzpyrene is a very potent carcinogen. This compound has been isolated from marine organisms in both oil-polluted and relatively clear waters. It is now being questioned whether 3,4,benzpyrene has become a global pollutant like DDT!

Synergistic effects of oil pollutants pose a further problem. Phenols and sulphuric acid, for example, act synergistically on growth rates (Gray & Ventilla 1971). Since the chlorinated hydrocarbon pesticides in the marine waters may be concentrated by increasing amounts of oil pollution in coastal waters, here is a further and continuing threat of these insecticides on marine food chains.

In light of these findings further oil pollution in an aquatic system already under stress could well tip the balance so that upgrading the water quality of this region would be increasingly difficult or impossible. In viewing the impacts of a refinery on this region it appears that mankind must begin to (1) reduce consumption of petroleum products, (2) restrict its use to essential processes, (3) search for alternative energy sources and, (4) share the available oil reserves with those underdeveloped countries which are merely seeking to produce adequate food and shelter for survival.

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A SUMMARY OF THE LEGAL ASPECTS OF LOCATING AN OIL REFINERY IN SOUTHEASTERN CONNECTICUT.

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REFINERIES

Refinery proposals have been made for Connecticut. They have been accompanied by proposals regarding deep water ports and offshore leasing. The three general environmental protection acts-The Environmental Protection Act of Connecticut, The Connecticut Environmental Policy Act, and the National Environmental Policy Act would apply as appropriate and will not be described in detail here.

One brief summary of the laws affecting refineries are set forth in Gilbert Bond's " The Environmental Law Explosion: Survey of Oil Pollution Laws Affecting the Oil Industry"(Journal of Business Law Vol. 26: 1039 April 1971).

I. PRODUCTION

Major federal permits are presently needed for offshore production of Army Corps of Engineers (33 USCA 1403). But the relative jurisdiction between state and federal control of submerged land is presently being contested in the Supreme Court. Under "Submerged Lands Act" (43 USCA 1301) the state claims control. Under the "Outer Continental Shelf Lands Act" (43 USCA 1331-43), the Secretary of the Interior issues leases as well as rules and regulations for protection, preservation of water and conservation (30 Code of Fed. Regs 250.43).

(There is, of course, a range of complicated liability rules governing oil spills which are contained in international conventions. Liability rules may also be covered by statutory duties, contract, negligence, and nuisance.)

II. TRANSPORTATION AND TERMINALS

There are variety of federal laws governing shipping as well as pipelines crossing federal lands. Connecticut Statutes Section 29-62 govern the transportation of flammable liquids. Under Connecticut laws, all terminals are licensed and inspected under Section 25-54cc of the Connecticut statutes.

Since the production and/or transportation can result in oil spills the laws governing oil spills are crucial. Of course, the major statute is the 1970 Water Quality Improvement Act which makes discharges "in harmful quantities" from vessels on shore facilities, offshore facilities, navigable waters, adjoining shorelines and contiguous zones are prohibited.

Regulations are issued under 35 Fed. Reg. 4306. (There is, of course, a range of complicated liability rules governing oil spills which are contained in internation conventions. Liability rules may also be covered by statutory duties, contract, negligence and nuisance.)

III. REFINERIES

Since refineries result in wastewater, as well as hydrocarbons and nitrogen oxides, they come under the Clean Water and Clean Air Acts. Connecticut has adoped a federally approved implementation plan which sets ambient air quality standard for the three districts of Connecticut. "The implementation of this act requires no air depuration in clean air areas). The emission standards are now to be issued for each emission source and would apply to a refinery.

(Two other regulations of air pollution should be mentioned: (1) The permit for new sources will be required under the federal legislation; (2) a permit for "complex sources" resulting indirectly in airpollution. One limitation on current air pollution controls relates to odors which may be covered by secondary standards, but not yet adopted.)

Water quality criteria have been issued by the federal government and states including Connecticut have adopted standards for each water body. A permit system has been implemented. The schedule of the permits, the conditions of the permits, and recent fine system would be relevant here.

Land use regulation of the selection of a refinery site currently rests primarily with local planning and zoning laws and bodies. (One locality may not be able to totally exclude a refinery). The Coastal Zone Management Act does not yet have a management plan adopted although one is currently under development. State permits for tidelands and wetlands may be required for the pipeline at the coast. Inland wetlands permits may be involved. Also in Connecticut, Section 7-160 of the Connecticut statutes provides that

> "No person or corporation shall refine crude or petroleum oil upon the shores of the waters of this state except under such regulations as are imposed by the selectmen of the city..."

A $50.00 a day fine is provided !

IV. TRANSPORTATION FOR THE REFINERY

There are a variety of state and federal laws governing the price of gasoline and transportation of it from the refinery.

CONCLUSION

The present laws do not provide adequate protection for a variety

of reasons: (1) limitations of powers (e.g. municipal zoning); (2) large discretionary powers (e.g. wetlands laws); (3) laws not yet in full force e.g. Coastal Wetlands); (4) lapse in laws (no statewide site location law); (5) ambiguity in laws (selectmen control of coastal refineries); (6) lack of strong administration of laws (clean air and clean water). Nevertheless, the laws do require several permits, thus permitting those seeking stringent regulation to press their case before appropriate regulating bodies. In the opinion of this author, any new regulations on refineries at the state level should be part of a broader state and land development controls.

SUPERTANKERS IN THE SOUND: HOW TO FRITTER AWAY A RESOURCE

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Several months back, Governor Meskill received two proposals for oil refineries in Southeastern Connecticut. The proposals he received were very general: one called for the creation of an island off the mouth of the Connecticut River, the other spoke of a site a few miles inland in the New London area. Both proposals mentioned that crude oil (either from foreign sources or from future oil developments on the outer continental shelf) would be brought into the Sound by supertankers and unloaded at offshore facilities.

Neither proposal has been presented to the state or the public in detail great enough to analyze accurately and thoroughly, although both In-O-Ven and PEPCO International have recently provided us with a few facts.

In response to these proposals, Meskill formed "The Governor's Fact Finding Task Force on Refineries." It was charged with evaluating the economic, social,and environmental effects of a refinery in Connecticut. The study was to be general and non-site specific, and was not to refer to either of the proposals.

When the Department of Environmental Protection (DEP) was asked to come up with the environmental impact assessment, I was requested to research the potential effects of supertanker traffic in Long Island Sound. As a result, I have scratched the surface of the tremendous body of literature on supertankers (VLCCs-- very large crude carriers) and have come up with some facts that could be of interest to people concerned about bringing those monstrous ships into Long Island Sound.

I should add, however, that the following discussion does not reflect the views of DEP. Since it is possible that the Department will be obliged to review well over a dozen refinery related permit applications(for air and water discharges, dredging, wetlands, etc.), any official editorial comment on either proposal could result in legal hassles. And regardless of the legal implications, it would not be appropriate for a state agency to make such comments. Therefore, I am speaking only for myself.

Customarily, supertanker captains pilot their ships on the high seas, but do not bring them into port. That job is left to the harbor pilots. Let us imagine that we are one of these pilots. We would be ferried out to an incoming VLCC in a launch when the supertanker was still several miles offshore, somewhere off the coast of Rhode Island. If the weather were good, we would have no trouble finding the ship. VLCC's are huge, with a capacity ten times that of the tankers that presently unload at the Thames River terminal in Groton.

Oil tankers are measured in deadweight tons (DWTs), which refers not to the weight of the ship itself, but to the weight of its contents when fully loaded. This includes the oil, ballast, and fuel for the ship's engine. In large tankers, the cargo makes up nearly all the deadweight tonnage. Conventional tankers used in Connecticut are usually around 28 to 30,000 DWTs; the largest tankers that can be accommodated at existing Connecticut ports are about 35,000 DWT. Today's supertankers vary from 150,000 to a half-million DWT, and there are plans for ULCCs-- ultra large crude carriers-- exceeding a million tons.

Several miles outside of Block Island sound, we climb aboard and take over the helm. The view from the helm would be an interesting one. The bow of the ship would be about 7 or 800 feet forward. In other words, we would have a panoramic view of about 4 acres of ship, and around the fringes of the view, some ocean. This would be somewhat worse than driving a car from the back seat. Over 100 feet below us would be the bottom of the hull; between 60 and 90 feet would be below water. A fully-loaded VLCC is much like an iceberg in that what you see above the water is only a hint of what's really there. If we were going 15 knots and tried to stop as quickly as possible, we could manage to do so in about 3½ miles. We would also experience considerable sideways slippage, which could be a problem in confined areas. If we wanted to do a U-turn, the circle would be about 4000 feet in diameter; in shallow water, somewhat wider.

Our ship will probably be propelled by one giant propeller powered by a huge engine. If the engine fails or the propeller becomes fouled, we will drift helplessly. If we need hull repairs, there will be no place to go, since there are no shipyard facilities on the east coast of the United States to handle ships this big.

There is one layer of steel between the thick, black Arabian crude and salt water. International agreements have excluded requirements for double hulls, which would keep the cargo from escaping in all but the most serious groundings and collisions. The U.S., unwilling to handicap its position in international trade by requiring double hulls, has supported the agreement.

In order to get into Long Island Sound, which is certainly deep enough to accommodate VLCCs, we must navigate Block Island Sound. Block Island Sound is not quite as deep as Long Island Sound, but it is adequate. The problems arise in entering these bodies of water. The deep-water entrance to Block Island Sound on its south side is too narrow for VLCCs. The largest deep water entrance is to the east, between Block Island and the Rhode Island mainland. So that is where we would head. The launch we came out in would probably precede us by a couple of miles. Its role would be that of the car that travels ahead of mobil homes on the highway, warning the traffic in the area of the wide load that follows.

A safe channel depth for supertankers up to 400,000 DWT in size is 105 feet, which allows for at least 15 feet of clearance beneath the hull of a loaded tanker. The existing natural channel between Block Island and mainland Rhode Island is slightly less than 4000 feet wide at this depth. This would not concern us much under normal conditions, but under adverse weather and heavy traffic conditions, things could get a bit tense. And almost all commercial traffic between Connecticut and points east uses this channel.

After negotiating this passage, and Block Island Sound we would reach the Race, a deep but narrow channel off the tip of Fishers Island. This is the only possible way loaded VLCCs can enter Long Island Sound. Tide currents are routinely swift, and next to nearby Plum Gut it is about the best fishing spot in the Sound. When the Blues and Stripers are running, there are literally hundreds of fishing boats out there. Tanker and freighter traffic from New London, Hartford, New Haven, Bridgeport and other harbors funnels through the Race. The channel, at a depth of 105 feet, is only 3800 feet wide. Again, the channel, under routine conditions, is wide enough, and the chances of an accident during any one trip are very small. But try to imagine steering a supertanker with millions of gallons of crude through the Race under non-routine conditions. A sudden squall lowers visibility and increases tidal velocities through the Race. A small boat slips between the warning vessel and the VLCC. Stopping distance, because of low speed, may be under a mile, but under emergency conditions a mile may not be enough.

You see that you're on a collision course with a barge or a disabled sailboat. You order "crash astern" or a sudden turn. Under the tense conditions you make an error in judgement and find yourself on the edge of the channel broadside to a strong current, and before you can urge the slow-moving ship into the clear, a submerged granite outcrop rips a hundred-foot-long gash in your hull.

A strong incoming tide immediately sweeps hundreds of thousands of gallons of oil into Long Island Sound long before containment equipment is anywhere near the site. Miles of Connecticut beaches are blackened, thousands of birds die, bottom sediments are contaminated, killing millions of benthic organisms. It would take years--possibly decades--for the Sound to recover, as it has taken years for Buzzards Bay, Mass. to recover from a large spill at Falmouth. Again, the possibility of such a disaster occurring on any single vessel trip is extremely small.But over a period of ten, 20, or 50 years, the possibility is far greater.

But let's suppose that doesn't happen this time and we successfully enter the Sound. A few miles ahead is our destination. If it is visible to us from the Race, it is probably a large offshore pier. If not, a single point mooring (SPM). These are the two most commonly used structures for off-loading oil from supertankers.

Single point moorings have a number of variations, but typically, they consist of a large buoy to which the ship moors. Attached to the

buoy is a swiveling connection to which a large floating house is connected. Oil is pumped from the tanker, through the hose, and then ashore through a buried pipeline. SPMs have a number of advantages. The VLCC needs no tug assistance to approach an SPM. It can approach the buoy from any direction. When it is within the necessary distance, a small boat moors the VLCC to the buoy and attaches the hoses. The supertanker can swing freely when it is moored to the buoy, reducing the danger of mishaps caused by wind and waves. SPMs are cheaper and less obtrusive than piers, and collision with one, since they will "give," would be less likely to cause hull rupture. On the other hand, the floating hoses are difficult to inspect and are somewhat likely to leak. Large maneuvering areas are needed to enable VLCCs to approach from any direction (direction of approach will vary according to weather and current conditions).

Because maneuvering areas limit possible SPM sites so severely, piers appear to be more practical in Long Island Sound. In-O-Ven apparently agrees; its proposal calls for a fixed berth. To moor at the offshore pier, we would bring the VLCC within a few hundred feet of the structure and parallel to it. Then two large tugs dispatched out of New London would nudge us gently sideways to the pier, and our job would be done.

Off shore piers (also called fixed berths and sea island piers) may be better in this case than SPMs, but they are far from ideal. They are more visible than SPMs, which is both good and bad. They can be seen more easily by ships, thus reducing the possibility of ramming, and they are more unsightly from the shore. Ships at most modern piers are pumped out with a so-called rigid-arm system, which is less prone to leakage than floating hoses. But if a tanker collides with a pier, even at a very slow speed, the danger of hull rupture is far greater that at a buoy. They are more expensive to build, and their construction is environmentally more disruptive since fifty or sixty piles must be driven. Oil companies like to point out that the superstructure of offshore piers provides habitat and shelter for marine life. This is true, but it also means that more organisms will be exposed to oil spills at the unloading site, and that the area may become somewhat congested with fishing boats.

Both kinds of facilities have other major drawbacks. They are a navigational hazard not only for VLCCs, but for any and all ships normally using the waters. That is why one of the basic considerations for siting offshore facilities is the amount of existing vessel traffic in the area. In Long Island Sound, it is high. Tankers, freighters, motorboats, sailboats, submarines, barges and ferries all use these waters. The danger of mishaps in foggy conditions is high, and a collision with a moored and unloading VLCC could be catastrophic.

Small operational spills are inevitable, no matter how many precautions are taken. They can occur for any number of reasons, including human error, mechanical failure, and pinhole leaks. Amounts may be small, but cumulative effects may be significant. Recent evidence, though still sparce, indicates that the long-term effects of numerous small spills may be even more serious than the rare and spectacular large accidents.

Visually, supertankers will be unsightly, especially unloaded ones. The fact that they must remain a considerable distance offshore will help, but they are very large and very visible indeed.

According to a document distributed by In-O-Ven, entitled "Energy, Environment, and Common Sense", an offshore pier will be constructed in Long Island Sound just about straight south of Harkness Park, and three miles from the tip of Millstone Point, where the nuclear power plants are. The pipeline from the pier will extend under the Sound to Millstone, and follow the existing utility right-of-way from the plant to Montville. According to the most recent navigational charts, water depths are inadequate three miles offshore; the facility would have to be located approximately 3 and 2/3miles offshore or the ships would run aground. This would place the pier almost directly astride the Connecticut-New York state line, which could arouse some jurisdictional hassles, and directly astride busy shipping lanes, which poses obvious problems.

Containment of oil spills occurring at the pier has been considered to a small degree; let's consider it a little further. Equipment will be kept at the pier for immediate deployment in case of emergency. However, conditions will be quite different at a mid-Sound pier than they are in the Thames River or New Haven Harbor. As far as I know, all oil containment systems now in common use are next to worthless in rough water. The recent spillage of over 100,000 gallons of oil at New Haven, even though it occurred inside the harbor, was inadequately contained. Large quantities of oil escaped, and the resulting slick extended as far as the Branford River.

Although conditions in Long Island Sound are far more manageable than on the high seas, chances are that wave height will frequently exceed the maximum conditions under which today's containment systems are effective. The Coast Guard and private firms have been working on booms for use in rough water, but these systems are not commonly used today. And it is highly unlikely that personnel trained to deploy this equipment will be on hand at all times.

One of In-O-Ven's chief arguments in favor of supertanker facilities and a refinery is the potential for reducing the number of oil spills. Since supertankers hold approximetely ten times the amount of oil that conventional tankers do, the number of vessel trips could be dramatically reduced; and one can say with a reasonable amount of confidence that the number of oil spills is in direct proportion to the number of vessel trips and the number of cargo transfers. However, a single disaster with a VLCC could be ten times as environmentally damag ing as with a conventional tanker. But the number of cargo transfers may not be based on the VLCC traffic alone, however, first assume that all of the oil products from a 400,000 barrel per day refinery are consumed in Connecticut, and that all these products are distributed by land--through pipelines, by truck, and by rail. In 1971, Connecticut's waterborne receipts of refined oil totalled 20,000,000 tons, delivered by 5,000 tanker trips. Use of In-O-Ven oil would, at 1971 consumption rates, reduce tanker trips from 5000 to a little over 1000. This would indeed be a dramatic reduction, and unless there was a catastrophic spill, oil pollution in Connecticut would in all probability be drastically reduced.

However, In-O-Ven officials have publicly stated that a large portion of their output would go to other New England states. Some would be shipped by pipeline, some by truck. They have also stated that 50% of their refined products would be transshipped by barge and conventional tanker to points in Connecticut and New England.

Consider these facts from a New England-wide perspective. Using In-O-Ven's own figure of a New England petroleum demand of 1.4 million barrels a day, the output of the Montville refinery would fill 14.3% of New England's need. Half of that, or 7.2% would be brought in by supertanker and distributed on land. Since supertankers can bring so much in so few trips, the portion of this 7.2% that might be spilled would be reduced.

The other half of In-O-Ven's oil, another 7.2% of New England's needs, would be brought in by supertanker, refined, loaded onto barges and tankers, taken to another New England port, and unloaded. As it is now, this 7.2% is usually transferred only once in New England. But if this 7.2% were transferred three times in New England, the chances of spillage would be greatly increased. This additional transferring of crude and refined oil would be expected to increase the total amount of oil spilled in New England, and would probably negate that other "safer" 7.2%.

From the local viewpoint, one cannot help but conclude that spillage probabilities in the New London area will dramatically increase with the addition of a 400,000 barrel per day refinery.

Finally, I have not considered the particulars of the facilities that will have to be built for the waterborne transshipment of refined products from the refinery. In-O-Ven has indicated that these facilities will be located in the Quaker Hill area. This raises all sorts of questions: How much dredging will be required to enable tankers to reach the loading facility? Is it compatible to existing land use in the area? Is the river wide enough at that point for the tankers and barges to maneuver safely? Those who have proposed the refinery have yet to deal with these questions.

In-O-Ven calls Long Island Sound "the best available harbor in the Northeast for a deep water port." That is debatable. They also call it "a precious natural resource that should be used, not abused or frittered away". That I think most of us agree with. All we have to do is decide what constitutes proper use, and what constitutes abuse. And that's not so easy.

NOTES ON TALK BY JEFFREY POTTER: OIL SPILLS

1. In terms of cleaning up oil spills there are no chemical compounds presently available which are non-toxic.
Straw and chalk are possible collecting agents; they congeal the oil so surface collection becomes easier. At the moment this is the most effective method of cleaning up oil spills.
Suction is the most ideal means of cleaning up oil but at the present time there are no suction devices available that have proven capable of cleaning up large oil spills. This method utilizes containment booms which usually surround the oil to prevent its spread and make clean up easier. The use of booms is restricted to situations where the current flow is less than 2 knots and the wave height is below 3 feet-there are of course, minor exceptions.
Attempts to burn off the oil have been largely unsuccessful in the past as a means of cleaning up oil spills.

2. About 3,600 marine "casualties" occurred last year; 96% due to human error-poor judgement, slow response, and wrong response. The Torrey Canyon's* fate was determined four minutes before the Captain recognized any danger and attempted to change course. The difficulty with these very large ships (VLCC's) is that they take large distances to stop (4-5½ miles) and are very difficult to manuever.

3. In inclement weather (ie.,hurricanes,etc.) it is the captain's decision to sail. Bonuses are given for reaching destination on time. Many decisions are influenced by financial considerations, which at times may prejudice safer sailing procedures.

4. After an oil spill marshes and estuaries are strongly effected, usually causing damage. In an oil spill off Puerto Rico the optimum recovery rate for oil soaked birds was only 2%.

5. The fixed berth off-loading facility at Northville on Long Island has in the past experienced damage caused by collisions with the off loading tankers. Because of hose failure the beaches in the area have been fouled at least twice.

* The Torrey Canyon was a supertanker which ran aground off Cornwall, England on March 18, 1967. It is estimated that almost all of its 119,000 plus tons of Kuwait crude oil was spewed into the sea causing one of the worst ecological disasters in history.